

ARTHROSCOPIC TREATMENT OF PATELLA FRACTURES IN CHILDREN

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Introduction. The frequency of patellar fractures is approximately 0.5% to 1.5% of all skeletal injuries. The following types of fractures can be distinguished: avulsive, transverse, longitudinal, and comminuted. In cases of displacement of more than 2–3 mm and quadriceps tendon injuries open reduction and internal fixation with the restoration of the articular surface is more preferable. In cases of longitudinal fractures, arthroscopy is regarded as a highly effective method of surgical treatment.

Materials and methods. Using arthroscopy, we have operated on 4 patients with longitudinal fracture of the patella. The average age of the injured persons was 15.4 years (14–17). These were 3 males and 1 female. All patients had sport-related injuries.

Because of the longitudinal fracture of the patella, the lateral knee extensor mechanism remained intact, and arthroscopy-assisted surgical intervention with closed reposition of fragments and transcutaneous wire fixation was performed without wire suturing.

Results and discussion. Minimal invasiveness, the possibility of visual control over the recovery quality of patellar surface, the reliability of fragment fixation, and a significant reduction in the subsequent rehabilitation make arthroscopy a highly effective method of surgical treatment for patellar fractures.

Keywords: the knee joint, fracture, patella, arthroscopy, pediatric patients.

ОПЫТ ЛЕЧЕНИЯ ПЕРЕЛОМОВ НАДКОЛЕННИКА С ПРИМЕНЕНИЕМ АРТРОСКОПИИ У ДЕТЕЙ

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Введение. По литературным данным, частота переломов надколенника составляет примерно от 0,5 до 1,5 % от всех повреждений скелета. По характеру перелома можно выделить авульзивные, поперечные, оскольчатые и продольные. При смещении фрагментов более 2–3 мм и повреждении сухожильного растяжения четырехглавой мышцы предпочтительна открытая репозиция с восстановлением конгруэнтности суставной поверхности и стабильным остеосинтезом. В случаях продольных переломов артроскопия может рассматриваться как высокоэффективный метод хирургического лечения.

Материалы и методы. С применением артроскопии нами были прооперированы 4 пациента с продольным переломом надколенника. Возрастной диапазон пострадавших варьировал от 14 до 17 лет. Из них 3 мальчика и 1 девочка. Все больные получили травму во время занятий спортом.

Поскольку при продольных переломах надколенника боковой разгибательный аппарат четырехглавой мышцы бедра оставался неповрежденным, объем оперативного вмешательства в этих случаях заключался в артроскопически ассистированной закрытой репозиции фрагментов и чрескожной диафиксации спицами без наложения проволоочного шва.

Результаты и обсуждение. Малоинвазивность, возможность визуального контроля за качеством восстановления геометрии суставной поверхности надколенника и надежностью фиксации фрагментов, существенное сокращение сроков последующей реабилитации делают артроскопию высокоэффективным методом хирургического лечения переломов надколенника.

Ключевые слова: коленный сустав, перелом, надколенник, артроскопия, подростки.

Introduction

Fractures of the patella are relatively rare in children [1]. According to the literature, the incidence of patella fractures is approximately 0.5% to 1.5% of all lesions of the skeleton. The patella protects the knee joint in front to some extent. However, at the same time, its anterior subcutaneous localization makes it vulnerable to direct injury, such as a knee bump against a car's instrument board or falling on the front part of the knee [2]. An indirect fracture can occur with a sharp and sudden violent contraction of the quadriceps muscle of the thigh [2, 3]. Therefore, the circumstances of injury are, as a rule, because of sports and traffic accidents [3].

By nature, we can distinguish avulsion, transverse, longitudinal, and comminuted fractures [4]. Children characteristically suffer from avulsion fractures of the lower or upper pole of the patella. These occur in more than half of all patella fractures. Then transverse fractures follow, and the most uncommon are comminuted fractures [4-6]. A distinctive feature of such fractures is the frequent combination of a fracture with the rupture of the medial and lateral tendon extensions of the quadriceps muscle of the thigh. Longitudinal fractures are the least common. With these fractures, there rarely is a disorder of the lateral extensor mechanism [2].

Because the patella plays a decisive role in the extension mechanism of the knee joint, the aim of any treatment is to restore the geometry of the patella articular surface and stable fixation of the fragments [5]. Otherwise, the probability of the development of patellar and femoral arthrosis and, as a consequence, the knee joint function disorder significantly increases [1, 3].

The nature of a fracture and the presence and degree of displacement of fragments are determined after an X-ray examination. Fractures of the patella with the displacement of fragments not exceeding 2–3 mm and minimal incongruence indicate the integrity of the extensor mechanism. In these cases, conservative treatment enables the achievement of positive results. Mostly, this approach is applicable in cases of avulsion fractures, when the degree of displacement of fragments is small [1, 5-7].

Fractures with the displacement of fragments more than 2–3 mm, as a rule, are accompanied by damage to the tendon extension of the quadriceps muscle and failure of the extensor mechanism.

Their treatment consists of open repositioning, congruence restoration and stable osteosynthesis supplemented by a suture of the tendon extension (the lateral extensor mechanism of the quadriceps). Surgical treatment is necessary in cases of transverse, comminuted, and longitudinal fractures [2, 5, 7].

Opinions vary on the optimal methods of surgical treatment of patella fractures. The accepted methods include a large number of tightening wire sutures and the use of screws, including cannulated, partial, or total patellectomy, while performing a suture or repair of the extensor mechanism. The nature and extent of the intervention are determined based on the specific situation [7, 8].

The disadvantages of open repositions are the traumatic nature and complexity of monitoring the restoration of congruence of the joint surface, which is one of the key positions that affect the restoration of joint function. To achieve the most accurate reposition of fragments, X-ray control is required; and the state of the cartilaginous cover is difficult to assess [2, 7, 9, 10].

Arthroscopy in combination with percutaneous osteosynthesis is free from these drawbacks. Low invasiveness and visual control at the stages of closed reposition and fixation of fragments are of undoubted interest, and in the case of intact medial and lateral tendon extensions of the quadriceps muscle enable the treatment of arthroscopy as a method of selecting surgical correction [8, 10].

An important stage in the treatment process in patients with patella fractures is the postoperative period, followed by rehabilitation and restoration of joint function. According to publications devoted to both open and arthroscopic methods of surgical treatments, fracture consolidation occurred in 6 to 7 weeks regardless of the treatment method [11-13]. Regarding the restoration of joint function, in the publications devoted to open methods, the authors noted persisting functional disorders for 8–12 weeks [13], and in some cases the functional disorders persisted for up to 12 months [12]. At the same time, other authors noted that the use of arthroscopy enables the shortening of the rehabilitation period up to 6 weeks, recognizing the arthroscopic internal fixation as an acceptable alternative for the treatment of patella fractures with displacement [8, 11].

Materials and methods

For 3 years (2013–2015), 4 patients (3 boys and 1 girl; age range, 14–17 years) with a longitudinal

fracture of the patella underwent arthroscopic surgery. All patients voluntarily signed an informed consent to participate in the study and undergo surgical intervention. All patients were injured while performing sports activities.

At the initial examination in all patients, the clinical picture of knee joint hemarthrosis was predominant. Because the clinical examination data, results of radiation diagnosis, and intraoperative arthroscopic findings in all patients were identical, we decided to illustrate our observations with the example of one patient.

Patient M., 16-years-old, was hospitalized with a clinical diagnosis of hemarthrosis of the left knee joint. Radiography of the knee joint in the straight and lateral projections was not informative. There were no bone-traumatic changes on the X-ray images (Fig. 1, 2).

After puncturing of the knee joint and immobilization, a clinical examination was repeated. During the examination, attention was drawn to the persisting pronounced local tenderness in the projection of the patella. Because of this, the spectrum of diagnostic measures was expanded, and ultrasound examination and computed tomography of the knee joints were performed (Fig. 3, 4).

The results of the expanded examination revealed the longitudinal fracture of the patella. To assess the condition of the patella cartilaginous cover, diagnostic arthroscopy was performed as the first stage of surgical treatment. The study was performed from a standard anterolateral access in a fluid medium. The arthroscopic pattern was identical in all patients. In cases of a longitudinal fracture of the patella, the fragments were mobile and unstable and the articular surface was incongruent (Fig. 5).

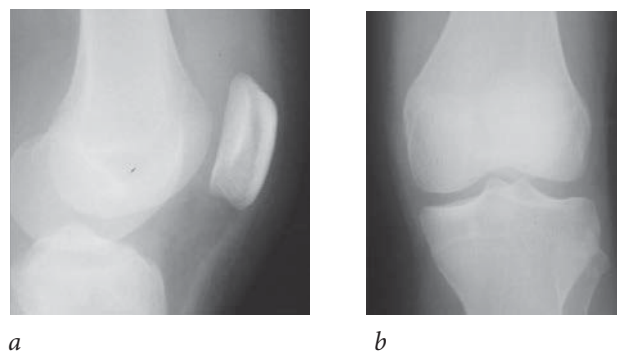


Fig. 1. Patient M., 16 years old. Radiography of the left knee joint (a) lateral projection), (b) direct projection

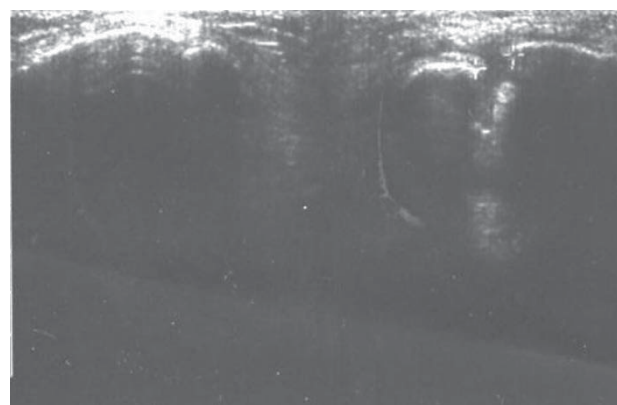


Fig. 3. Patient M., 16 years old. Ultrasound examination of the knee joints reveals a fracture of the left patella

At that point, the medial and lateral tendon extensions of the quadriceps muscle were not affected. Intraoperative findings enabled to reposition the fragments as a single step under video control. The reposition was performed intra-articularly with an arthroscopic hook passed through the anteromedial access with a simultaneous manual handling from outside.

After repositioning, the fragments were retained in the reduced state, and at the same time, percutaneous osteosynthesis was performed with

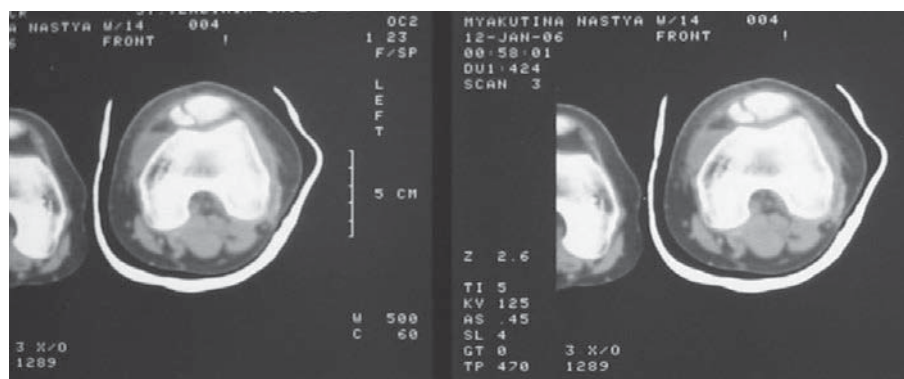


Fig. 4. Patient M., 16 years old. Computed tomography of the knee joints shows a longitudinal fracture of the left patella

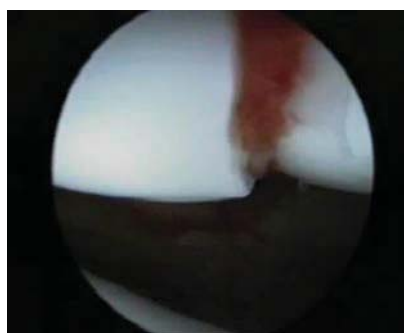


Fig. 5. Patient M., 16 years old. Arthroscopy of the left knee joint shows a longitudinal fracture of the patella with displacement

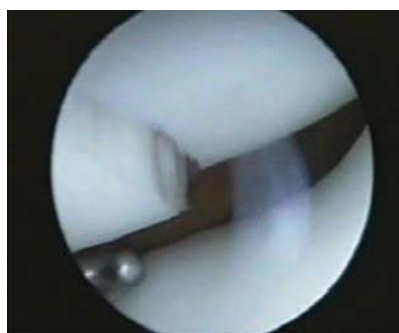


Fig. 6. Patient M., 16 years old. Stage of repositioning of the patella fragments under arthroscopic control

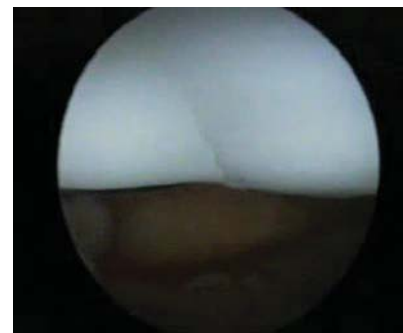


Fig. 7. Patient M., 16 years old. After elimination of the articular surface deformity of the patella, the fragments were fixed percutaneously

2 wires passed in a horizontal plane at an angle of approximately 45° to each other. The wire suture was not overcast. Video control enabled to assure the stability of the osteosynthesis (Fig. 7).

In the postoperative period, immobilization was achieved by a plaster splint for 6 weeks. Rehabilitation started from week 4 after the surgery. This was the first period of rehabilitation, which lasted for 2 weeks. At this time, the patient still wore a plaster cast; therefore, all exercises were performed while standing on crutches or in the prone position. After the fracture union, termination of immobilization, and removal of the metal fixers, the second course of rehabilitation was begun for 2 weeks to eliminate the post-immobilization stiffness of the knee joint. The completion of the rehabilitation period was a return to the previous level of physical load. Overall, the duration of rehabilitation was 6 weeks.

Results and discussion

Analysis of clinical data and the results of X-ray diagnostics and therapeutic and diagnostic arthroscopy showed that the therapeutic and diagnostic algorithm has some special characteristics with longitudinal fractures of the patella. The informational value of traditional radiography may be insufficient. Overlapping of the X-ray shadow of the patella on the shadow of the condylar-femoral complex in the direct projection and layering of the shadows on the patella fragments in the lateral projection increase the probability of a diagnostic error. Therefore, it is advisable to include ultrasound examination and computed tomography of the knee joints in the range of diagnostic measures. After establishing the diagnosis, surgical intervention is advisable to start with therapeutic and diagnostic arthroscopy. This enables to visually assess the state

of the cartilaginous cover of the patella and femur, to confirm the intactness of the extensor mechanism of the quadriceps, and to reposition the fragments in combination with percutaneous wires under arthroscopic control. In case the ligaments retaining the patella remain intact, percutaneous osteosynthesis is sufficiently stable and enables to avoid additional wire sutures. The low injury rate of arthroscopy enables an early initiation of rehabilitation, even before the termination of immobilization, which shortens the period of restoration of the joint function.

The duration of follow-up was 1.5 to 4 years. of the treatment results were evaluated using the scale of subjective assessment of the knee joint IKDC (International Knee Documentation Committee). The average value was 92.3 (range, 87.3–96.5). In all cases, it was possible to restore the joint function and return to the previous level of physical load. This enables to consider arthroscopy in combination with percutaneous osteosynthesis as a highly effective method of surgical treatment.

Therefore, low invasiveness, the possibility of complete visual control over the quality of restoration of the patella articular surface geometry and the reliability of fixation of fragments, and shortening the terms of subsequent rehabilitation and beneficial cosmetic result make the use of arthroscopy, in the treatment of patients with patella fractures, feasible and expedient.

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